Economics and Irrigation Water Management

ECONOMICS: The study and method that deals with the production, distribution, and consumption of commodities.

In other words, a farmer needs to be concerned about what is being produced and what is being used to produce it.

Decisions by a producer ultimately come down to one basic question: "Is, what I'm about to do, worth it?"

Worth can certainly be measured in terms of money, but worth can also be measured in terms of time, effort, quality of life, and quality of the environment. The worth of a change can be determined by answering the following three questions:

1. Why do this at all?

This begs an answer to the question – Can the present method sustain itself indefinitely? If the present method can sustain itself, then change is optional. If the present method cannot sustain itself, then there is no option but to change.

2. Why do it now?

Compelling reasons to change at this time can be manifold, such as:

a. A change can produce higher profit,
b. A change can reduce effort, or
c. If I don't change, I'm out of business.

3. Why do it this way?

There are generally many ways to accomplish a particular task. How do we know if the best option is being used? Specifically, the inputs and the results of those inputs need to be evaluated.

EXAMPLE: A farmer has a conventional center pivot system (60 psi) covering 125 acres, with water supplied from a 500 GPM well with a drawdown to 400 feet below the surface. Electricity cost $0.12 per KWH. Well water quality is 1000 ppm TDS (WQ-6). Of the 18 inches of annual precipitation, 1/2 is effective and evenly spaced from May through August. Potential[(1)] crop consumptive use (CU) averages 0.25 "/day in May, 0.30 "/day in June, 0.35 "/day in July, and 0.30 "/day in August (IWM-19 and Irrigation Guide) (Assume production is directly related to the actual CU and is worth $25 per acre inch of CU.). The farmer is considering converting to a LEPA system which will cost $10,000.

Make the necessary assumptions and evaluate options.

Items Common to All Systems:

Well Capacity = 500 GPM (26.52 Ac-Inches / Day)
Well Drawdown = 400 Feet
Pumping Plant Efficiency, Overall = 60%
Electricity cost = $0.12 / KwH
Well Water Salinity = 1,000 ppm
Crop Value = $25 per inch of effective rain and irrigation water

Effective Rainfall during season = 9 inches (0.073 "/day)
Crop Potential CU for season = 36.9 inches divided as follows:
= 0.25"/Day in May,
= 0.30"/Day in June,
= 0.35"/Day in July, and
= 0.30"/Day in August

SYSTEM COMPARISONS

ITEM	Existing	LEPA	ALTERNATIVE LEPA
Area	125 Acres	125 Acres	100 Acres(3)
System Pressure	60 PSI	30 PSI	30 PSI
Irrigation Application Efficiency	65 %	90%	90%
Water to apply per day (2), inches			
- May (0.25)	0.272	0.197	0.197
- June (0.30)	0.349	0.252	0.252
- July (0.35)	0.426	0.308	0.308
-August (0.30)	0.349	0.252	0.252
Pump Operation Time, Hours (4)			
- May (744)	954*	691	553
- June (720)	1,191*	860*	688
- July (744)	1,494*	1,080*	864*
-August (744)	1,224*	884*	707
Water Pumped During Season, Ac-Ft	271.82	266.96	247.89
EXPENSES			
Pump Electricity Cost –	$9.10/hr	$7.93/hr	$7.93/hr
- May (744)	$6,770*	$5,480	$4,385
- June (720)	$6,552*	$5,710*	$5,456
- July (744)	$6,770*	$5,900*	$5,900
-August (744)	$6,770*	$5,900*	$5,607
Annual Pumping Cost	$26,862	$22,990	$21,348
Capital Cost for the new LEPA system ($10,000, 7%, & 10 year life - CRF =0.1424)	-0-	$1,424	$1,424

Crop Establishment[(5)]	**$12,500**	**$12,500**	**$10,000**
Fertilizer[(6)]	**$21,293**	**$15,833**	**$12,667**
Per-Acre Annual Cost	**$485.25**	**$421.98**	**$454.39**
PRODUCTION AND INCOME [(7)]			
Irrigation Water Applied / Acre	**26.10 inches**	**25.63 inches**	**29.75 inches**
Effective Irrigation and Rain, aka CU.	**25.97 inches**	**32.07 inches**	**35.78 inches**
Based on $25 / Inch of CU [(8)]	**$649.25 / acre**	**$801.75 / acre**	**$894.50 / acre**
Yield loss due to salinity	**20% = ($129.85) / acre**	**10% = ($80.18) / acre**	**0%**
Net income / acre	**$34.15**	**$299.59**	**$440.11**
Net Annual Income for Farm	**$4,268.75**	**$37,448.75**	**$44, 011.00**

NOTES for this example:

(1) Actual Consumptive Use is less than potential Consumptive Use because of growing conditions such as water limitations and salinity. This principle is readily apparent in high frequency, low salinity environments, such as with some drip irrigation systems.

(2) To determine the amount of "water to apply per day", subtract the effective rainfall from the potential CU and divide by the application efficiency – E.g. Existing system for May: (0.25" – 0.073") / 0.65 = 0.272" equals the amount of water that has to be applied per day in order to meet the potential CU.

(3) To determine the area for the Alternative LEPA system, the daily well capacity is divided by the average water to apply per day for the growing system as follows: (26.52 Ac-Inches / Day) / ((0.197 + 0.252 + 0.308 + 0.252) / 4) = 105 Acres.

(4) The asterisk (*) indicates that there are not enough hours in a month to meet the water requirement and thus the pumping cost is capped at the number of hours in a month.

(5) Crop establishment includes all cultivation practices, to include planting and seed cost, needed to establish a crop.

(6) Fertilizer – Assume the crop needs 150 units of N per acre and it is applied through the system. Also assume that the amount of nutrients that is used by the crop is dependant upon the efficiency of the irrigation system. Assume that more N will be applied to compensate for the irrigation application efficiency and that N is from Urea at $700 per ton – or $0.76 per unit of N.
(7) Production is assumed to be based upon the amount of water applied minus corrections for salinity. Production in some crops is more affected by salt than others.
(8) Production is very responsive to water quantity, up to the potential CU. This is very evident in Alfalfa.

DISCLAIMER:

The above example is simplified for purposes of instruction. Some of the assumptions that would be verified for actual conditions are as follows:

A. Pump and motor efficiency, flow rate, pressure, and power consumption would be determined and matched to the irrigation system,
B. Crop CU would be determined for the crop and location, and
C. All expenses and projected income would be verified for the specific time and location.

NOTES on Capitol Recovery Factor (CRF): This factor can be very useful to help determine the cost of an investment or purchase versus expected income. The following is an abbreviated table, a short explanation of CRF, and a simple example:

Capitol Recovery Factors

Lifespan Years	Interest Rate - % 4	5	6	7	8	10
1	1.0400	1.0500	1.0600	1.0700	1.0800	1.1000
2	0.5302	0.5378	0.5454	0.5531	0.5608	0.5762
5	0.2246	0.2310	0.2374	0.2439	0.2505	0.2638
10	0.1233	0.1295	0.1359	0.1424	0.1490	0.1628
15	0.0899	0.0963	0.1030	0.1098	0.1168	0.1315
20	0.0736	0.0802	0.0872	0.0944	0.1019	0.1175
25	0.0640	0.0710	0.0782	0.0858	0.0937	0.1102
50	0.0466	0.0548	0.0634	0.0725	0.0817	0.1009
100	0.0408	0.0504	0.0602	0.0701	0.0800	0.10001

The CRF x Present Debt = the uniform end-of-year payment necessary to repay the debt in a given number of years at a given interest rate.

Example: A farmer buys an irrigation system for $20,000. It is financed for 10 years at 7% interest rate (Hint: From the chart, the CRF = 0.1424).
Question: What is the Annual Payment?
Answer: Annual Payment = 0.1424 x $20,000 = $2,848 / year